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ABSTRACT

The revised approach to teaching and learning math in the United States emphasizes the mental processes involved in doing math and focuses partly on children's prior knowledge, out-of-school experiences, and informal mathematics knowledge. This engaging approach can function to encourage children to select one of the mathematical sciences as an occupation. This digest describes several conditions that are necessary before this can occur. Some factors that must be present include an increased focus on the paradigm of problem solving in math, as well as an effort to provide teachers with professional development concerning the goals of instruction and student learning. Those who have a stake in a child's development need to help reform the current state of low involvement in math and science. School counselors are in the important position to help increase the number of students who select a mathematical science as a career option. Counselors can reduce biases by assisting in maintaining a balance between the mathematical preparation of all students instead of the trend towards encouraging only a select few to take higher-level mathematics courses. They can assist teachers to critically examine their relationships with students and help them provide opportunities for all students in their classes. They can facilitate the infusion of career exploration and knowledge of the mathematical sciences into all course content beginning in kindergarten. Beginning early in a student's academic life, the connection between what is being learned in school and future careers and life roles should become an explicit part of everyday learning. (Contains seven references.) (JDM)

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Careers in the Mathematical Sciences: The Role of the School Counselor

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ERIC DIGEST

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Careers in the Mathematical Sciences: The Role of the School Counselor

Marie F. Shoffner & Nancy N. Vacc

"The more things change, the more they remain the same." This old cliche seems to have much relevance today as it concerns individuals selecting one of the mathematical sciences, including engineering and computer science, as a career choice. Although there has been an increase in career options in the mathematical sciences due to the recent advances in technology and its applications, the number of individuals selecting a career in this field has changed very little.

Based on research, selecting a career involves a process that includes a person's background, personal qualities, motivation, and environment (Farmer, 1987). Therefore, if the number of individuals seeking a career in one of the mathematical sciences is to increase, efforts are needed to influence these factors beginning in the early school years. Some statistics that have a bearing on the importance of attracting children to the mathematical sciences include the following: (a) nearly 75% of tomorrow's jobs will require the use of computers; (b) 34% of high-school-age girls reported being advised by a faculty member to not take senior mathematics; (c) African Americans make up 12% of the population but only 2% of all employed scientists and engineers; (d) Hispanics comprise 9% of our population but only 2% of the individuals employed in science and engineering, (e) Native Americans make up .6% of the population but only .5% of all employed scientists and engineers, and (f) European-American women represent 43% of the population but only 10% of all scientists and engineers (North Central Regional Educational Laboratory, 1999). Is the problem of a small number of individuals selecting a career in the mathematical sciences caused by a negative attitude toward mathematics or by limited exposure to extracurricular activities in mathematical sciences, or is the problem the result of children lacking career information?

While we started this paper with the cliche that as things change, they remain the same, we believe that this may be the best time ever to encourage young people to select careers in the mathematical sciences. In large part, this is due to recent changes in the way that the mathematics curriculum is being approached in the United States. The current view of the mathematics paradigm has moved away from a focus on facts and computation to a focus on mathematics as problem-solving. This revised approach to teaching and learning mathematics emphasizes the mental processes involved in doing mathematics and in part focuses on children's prior knowledge, out-of-school experiences, and informal mathematics knowledge. This provides a much more engaging and interesting approach in the mathematics curriculum. As a result, we are now at a threshold whereby we can engage children in mathematics instruction in a way that encourages them to select one of the mathematical sciences as an occupation.

In order for change to occur, however, several conditions are necessary. First, there must be an increased focus on the paradigm of problem solving in mathematics and a movement away from the traditional curriculum of drill and practice. Second, there needs to be an effort to provide teachers with professional development concerning the goals of instruction, student learning, and their own beliefs about the mathematical sciences. Third, individuals who have a stake in a child's development need to help reform the current state of low involvement in the mathematical sciences, especially since preparation in mathematics is becoming increasingly important in many professional fields. Major contributors to this effort are school counselors, who are in a unique position to help increase the possibility of students selecting one of the mathematical sciences as a career. The various efforts that can be made in this area are presented below.

Role of the School Counselor

There are two inadvertent biases that may affect students as they think about their potential careers in the mathematical sciences: 1. that careers in mathematics are only for those with outstanding mathematics potential, and 2.that various demographic factors (e.g., gender and ethnicity) predetermine mathematics achievement and appropriate career choice. Counselors can intervene in various ways: 1. They can reduce these inadvertent biases by assisting in maintaining a balance between the mathematical preparation of all students and encouraging only a select few to take higher level mathematics courses (Peterson, 1993). 2. Counselors can assist teachers to critically examine their relations with students and help them provide opportunities for all students in their mathematics courses (Davenport, 1994). This, in turn, can affect student attitudes toward future careers in the mathematical sciences, as well as students' beliefs regarding their abilities to achieve

CG029655

in mathematics. 3. Counselors can facilitate the infusion of career exploration and knowledge of the mathematical sciences into all course content beginning in kindergarten. Encouraging teachers to provide opportunities for students to increase their awareness of potential careers in mathematics can help reduce the biases which students may have about mathematics careers.

School counselors also can help increase family collaboration by working closely with parents to increase family-school communication, and by providing parents with the skills and attitudes necessary to encourage their children to make appropriate career choices. Parents' beliefs about mathematics influence children's beliefs. For example, parents with mathematics-related anxiety who are working with their children on mathematics homework will directly impact the comfort level of their children toward mathematics, and thus toward a career in the mathematical sciences.

When working with students in classrooms, small groups, or individually, school counselors can utilize a process of intervention that focuses on general skills and attitudes, career education, and mathematics. For example, counselors can help to coordinate activities that focus on skills and attitudes related to mathematics. As Lee (1993) found, integrating a classroom guidance unit on school success into the school curriculum can result in significant gains in mathematics scores. School counselors also can work with students to address confidence, self-assurance, self-worth, and positive attitudes (Fouad, 1995). Together with teachers and parents, school counselors can be instrumental in increasing the self-efficacy beliefs of youth regarding their ability to succeed with higher level course content, and to pursue careers in mathematics. One way to achieve this is to provide children and adolescents with successful experiences and role models beginning as early as kindergarten (e.g., bringing in adults with careers in one of the mathematical sciences to talk about their work and educational background).

Counselors also can work with students to increase their decision-making skills and their ability to generalize problem-solving skills to multiple types of challenges. In addition, counselors can encourage all educators to make a concerted effort to increase students' connections to counselors, teachers, and other adults who can provide guidance in preparing them for the future by providing support networks such as clubs, tutoring, and mentoring for students, especially those representing under-represented groups.

School counselors play a critical role in providing appropriate career education and guidance for all youth. Beginning early in a student's academic life, the connection between what is being learned in school and future careers and life roles should become an explicit part of everyday learning in the schools. School counselors can be instrumental in encouraging career aspirations, providing accurate information about local and national labor trends to help students make better informed choices, and offering opportunities for students to learn about careers in mathematics from under-represented groups employed in the mathematical sciences. By the middle of high school, students should possess some degree of occupational knowledge as well as information regarding the competencies and education needed for various career paths. Therefore, prior to this time, it is important that school counselors discuss and explore issues of bias and under-representation in mathematics with students. Counselors also can provide career investigation and decision-making activities so that these various interventions can be placed in the context of individual abilities and interests.

In specifically targeting careers in the mathematical sciences, school counselors can provide guidance and counseling to address perceptions, support, attitudes, and achievement. Thus, counselors, together with teachers, parents, and administrators can help students increase their awareness of the value of mathematics. In middle and high school, counselors can ensure that all students are exposed to high-level mathematics by increasing mathematics course choices and achievement. Lack of career guidance is often stated as the reason behind poorly informed post-secondary and career decisions (Fouad, 1995). Relatedly, due to the nature of most mathematics curricula, students who forego certain mathematics courses have a difficult time reentering a mathematics career path (Rayman & Brett, 1993). Therefore, assisting students in selecting appropriate mathematics courses, and following an appropriate curriculum is vital to ensuring that educational and career options are not foreclosed too early.

Clearly, school counselors are in the important position of helping to increase the number of students who select one of the mathematical sciences as a career option. The activities suggested above are a means through which counselors can begin to initiate this needed change.

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